

while the magnetic coupling bias direction of the antiferromagnetic layer having a higher T_b is kept stable as it is, the magnetic coupling bias direction of the antiferromagnetic film having a lower T_b is settled, whereby the magnetic coupling bias fields of the two could be made perpendicular to each other.

Concretely, the antiferromagnetic film 152 may be an antiferromagnetic film of PtMn, PdPtMn or the like capable of expressing H_{UA} through thermal treatment. For this, however, more preferred is any of RhMn, IrMn, RhRuMn, FeMn or the like having T_b of from 200 to 300°C, since they can be subjected to thermal treatment at temperatures at which the pinned magnetic layer is stable. For the antiferromagnetic layer in the spin valve film, preferred are antiferromagnetic substances having a higher T_b , such as IrMn, PtMn, PtPdMn, etc. Using those preferred antiferromagnetic substances, the magnetic coupling bias direction of the antiferromagnetic film 152 could be well settled in the track width direction without disturbing the magnetization direction of the pinned magnetic layer in the spin valve film in the step of thermal treatment for resist curing noted above. Specifically, because of the characteristic of the invention where the pinning magnetization is rapidly stabilized at temperatures not higher than the blocking temperature, the longitudinal bias and the magnetization of the pinned magnetic layer could be made well

perpendicular to each other even though the difference in the blocking temperature between the both antiferromagnetic films is only tens °C. When IrMn, FeMn, RhMn, RhRuMn, CrMnPt, CrMn or the like capable of producing a magnetic coupling bias field during deposition them in a magnetic field is used for the antiferromagnetic film 152, it does not require any additional thermal treatment. Therefore, the antiferromagnetic film 152 of any of those substances, not requiring additional heat treatment, does not disturb the bias magnetic field direction of the antiferromagnetic layer 143 in the spin valve film. To be combined with the film 152 of that type, any and every type of antiferromagnetic substances could be used for the antiferromagnetic layer 143 in the spin valve film, and in any combination of the two, the longitudinal bias direction and the magnetization direction of the pinned magnetic layer could be made well perpendicular to each other.

On the other hand, as in Fig. 27, only the protective film 147 at the track edges of the free layer may be etched away, and an antiferromagnetic film may be laminated thereover through magnetic coupling to apply a longitudinal bias to the free layer. In this case, it is desirable that the longitudinal bias layer 15 comprises an antiferromagnetic layer 152 and a buffer layer 1511, which is a underlayer for enhancing the magnetic coupling with the free layer. The buffer layer 1511 is preferably a ferromagnetic layer of Fe,

Co, Ni or the like. For settling the magnetization direction of the longitudinal bias in this case, the same as in the above-mentioned case of ferromagnetic layer 151/antiferromagnetic layer 152 could apply also to this case. The longitudinal biasing system using such a ferromagnetic layer is advantageous in that the Barkhausen noise is effectively removed therein, without generating any unnecessary longitudinal bias magnetic field to lower the sensitivity of heads as in the system using a hard magnetic film.

Third Embodiment:

Fig. 28 shows the third embodiment of the invention. In Fig. 28, the structure of the spin valve film differs from that in Fig. 21. In Fig. 27, a spin valve film 14 formed on a lower gap 12, and comprises a nonmagnetic underlayer 141 of Ta, Nb, Zr, Hf or the like having a thickness of from 1 to 10 nanometers, an optional second underlayer 142 having a thickness of from 0.5 to 5 nanometers, a free layer 146, an interlayer 145 having a thickness of from 0.5 to 4 nanometers, a pinned magnetic layer 144, an antiferromagnetic layer 143, and an optional protective film 147 having a thickness of from 0.5 to 10 nanometers. In this, free layer 146, the interlayer 145, the pinned magnetic layer 144 and the antiferromagnetic layer 143 are the same as those in the second embodiment.

Where the underlayer 142 is of Au, Cu, Ru, Cr, Ni, Ag,